

*Journal of*

# **Computational Physics**

*VOLUME 95, 1991*



**ACADEMIC PRESS, INC.**

Harcourt Brace Jovanovich, Publishers

**San Diego New York Boston**

**London Sydney Tokyo Toronto**

Copyright © 1991 by Academic Press, Inc.  
All Rights Reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owner.

The appearance of the code at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per copy fee through the Copyright Clearance Center, Inc. (27 Congress Street, Salem, Massachusetts 01970), for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. Copy fees for pre-1991 articles are as shown on the article title pages; if no fee code appears on the title page, the copy fee is the same as for current articles.

0021-9991/91 \$3.00

This journal is printed on acid-free paper.



*Printed by Catherine Press, Ltd., Brugge, Belgium*

# CONTENTS OF VOLUME 95

## NUMBER 1, JULY 1991

GERHARD LANDL, THOMAS LANGTHALER, HEINZ W. ENGL, AND HARALD F. KAUFFMANN. Distribution of Event Times in Time-Resolved Fluorescence: The Exponential Series Approach—Algorithm, Regularization, Analysis . . . . .	1
J. A. VIECELLI AND E. H. CANFIELD, JR. Functional Representation of Power-Law Random Fields and Time Series . . . . .	29
H. BÖING, K. WERNER, AND H. JACKISCH. Construction of the Entropy Solution of Hyperbolic Conservation Laws by a Geometrical Interpretation of the Conservation Principle. . . . .	40
B. LARROUTOUROU. How to Preserve the Mass Fractions Positivity when Computing Compressible Multi-component Flows . . . . .	59
G. CAGINALP AND E. A. SOCOLOVSKY. Computation of Sharp Phase Boundaries by Spreading: The Planar and Spherically Symmetric Cases . . . . .	85
DAVE RAMSDEN AND GREG HOLLOWAY. Timestepping Lagrangian Particles in Two Dimensional Eulerian Flow Fields . . . . .	101
W. D. D'HAESELEER, W. N. G. HITCHON, AND J. L. SHOHEIT. Self-Consistent Numerical "Bounce-Averaged" Transport Computations in Stellarators Employing a Multi-mesh Approach . . . . .	117
R. C. BROWER, N. A. GROSS, AND K. J. M. MORIARTY. Accelerated Monte Carlo by Embedded Cluster Dynamics . . . . .	167
CARLO F. BARENGHI. Computations of Transitions and Taylor Vortices in Temporally Modulated Taylor-Couette Flow . . . . .	175
WILLIAM S. LAWSON AND PERRY C. GRAY. Heat Flow between Species in One-Dimensional Particle Plasma Simulations. . . . .	195
F. SOTIROPOULOS AND S. ABDALLAH. The Discrete Continuity Equation in Primitive Variable Solutions of Incompressible Flow . . . . .	212
JIE SHEN. Hopf Bifurcation of the Unsteady Regularized Driven Cavity Flow . . . . .	228
ABSTRACTS OF PAPERS TO APPEAR IN FUTURE ISSUES . . . . .	246

## NUMBER 2, AUGUST 1991

IN MEMORIAM: Sid Fernbach 1917–1991 . . . . .	251
REVIEW ARTICLE	
D. F. HAWKEN, J. J. GOTTLIEB, AND J. S. HANSEN. Review of Some Adaptive Node-Movement Techniques in Finite-Element and Finite-Difference Solutions of Partial Differential Equations . . . . .	254

# REGULAR ARTICLES

CHARLIE H. COOKE AND ANDREW G. MCMORRAN. Asymptotic Factorization of Operators in Complex Time . . . . .	303
JEFFREY C. BUELL. A Hybrid Numerical Method for Three-Dimensional Spatially-Developing Free-Shear Flows . . . . .	313
A. R. MITCHELL, B. A. MURRAY, AND B. D. SLEEMAN. Numerical Solution of Hamiltonian Systems in Reaction-Diffusion by Symplectic Difference Schemes . . . . .	339
P. DEMARET AND M. O. DEVILLE. Chebyshev Collocation Solutions of the Navier-Stokes Equations Using Multi-domain Decomposition and Finite Element Preconditioning . . . . .	359
F. J. ASECOR AND M. PANIZO. Finite-Difference Operators in Anisotropic Inhomogeneous Dielectrics: General Case . . . . .	387
ZHI YUN LU AND TIMOTHY J. ROSS. Diffusing-Vortex Numerical Scheme for Solving Incompressible Navier-Stokes Equations. . . . .	400
PRABIR DARIPA. Solvability Condition and Its Application to Fast Numerical Solution of Overposed Inverse Problems in Compressible Flows . . . . .	436
ARKADY S. DVINSKY. Adaptive Grid Generation from Harmonic Maps on Riemannian Manifolds . . . . .	450
GEERTJAN HUISKAMP. Difference Formulas for the Surface Laplacian on a Triangulated Surface. . . . .	477

## NOTES

J. DOUGLAS BEASON, DAVID S. KERSHAW, AND MANOJ K. PRASAD. Using Physical Insight: The Relativistic Compton Scattering Kernel for Radiative Transfer. . . . .	497
H. KOBEISSI AND K. FAKHREDDINE. The Canonical Functions Method and Singular Potentials. . . . .	505
ABSTRACTS OF PAPERS TO APPEAR IN FUTURE ISSUES . . . . .	511
AUTHOR INDEX FOR VOLUME 95 . . . . .	514



INFORMATION FOR AUTHORS

The purpose of the *Journal of Computational Physics* is to publish articles concerning techniques developed in the solution of data handling problems and mathematical equations, both arising in the description of physical phenomena.

Manuscripts should be submitted to: The Editors, *Journal of Computational Physics*, University of California, Lawrence Livermore National Laboratory, P. O. Box 5509, L-561, Livermore, California 94550, U.S.A.

Only original papers will be considered. Manuscripts are accepted for review with the understanding that the same work has not been and will not be nor is presently submitted elsewhere, and that its submission for publication has been approved by all of the authors and by the institution where the work was carried out; further, that any person cited as a source of personal communications has approved such citation. Written authorization may be required at the Editors' discretion. Articles and any other material published in the *Journal of Computational Physics* represent the opinions of the author(s) and should not be construed to reflect the opinions of the Editors and the Publisher.

Authors submitting a manuscript do so on the understanding that if it is accepted for publication, copyright in the article, including the right to reproduce the article in all forms and media, shall be assigned exclusively to the Publisher. The Publisher will not refuse any reasonable request by the author for permission to reproduce any of his or her contributions to the journal.

**Form of Manuscript.** Manuscripts should be typewritten with wide margins on high quality 8.5 × 11-in. bond paper, using double spacing throughout. If larger paper must be used, the text must still be within these dimensions. A minimum of three copies should be submitted; however, in order to expedite handling of manuscripts, five copies are desirable. The original of the manuscript and figures (including computer-generated data) need not be submitted until acceptance, as long as the copies are clear and reproducible. Figures and tables must be in all copies.

Each page of the manuscript should be numbered consecutively. Page 1 should contain the article title, author, and coauthor names with complete affiliation(s). At the bottom of this page should appear the subject classifications and key words (see below). Page 2 should contain a proposed running head of less than thirty-five characters. It should also contain the name and complete mailing address of the person to whom proofs are to be sent. Page 3 of full articles should contain a short abstract.

All submitted papers will be scrutinized for length, particularly if they exceed 20 journal pages in length (including graphs, tables, references, etc.) and if the author has published in the Journal within the previous year.

**Notes.** Short notes of 10 pages or less (including figures, tables, and references but excluding title pages) regarding the availability of interesting and useful new programs or tabular material will be considered for publication. Letters to the Editor commenting on articles already published in this Journal will also be considered. Neither notes nor letters should have an abstract.

With the exceptions noted below, authors should be guided by the *Style Manual*, 1978, of the American Institute of Physics.

**Subject Classification.** Authors are required to classify their own manuscripts using the 1980 *Mathematics Subject Classification*, 1985 revision, reprinted in the 1987 *Mathematical Reviews Index* and/or from the additional classifications listed in the January 1989 issue of *Journal of Computational Physics*. Authors are requested to choose at least two categories—one in numerical analysis category 65, and one other (generally a physical classification) from the categories beyond 65. Also include a few key words.

**List of Symbols.** If the paper is accepted for publication, it is of vital importance that the author submit a complete list of symbols. The symbols used should be identified for the typesetter **phonetically**. This list will not appear in print but is essential to avoid costly corrections in proof. The author may prepare his or her own list or use a preprinted form supplied by the Editors.

**Tables.** Number tables consecutively with Roman numerals. Extensive tables will be reproduced photographically and should be typed carefully in the **exact** format desired. Authors will be charged for any new photoreproductions necessitated by changes in proof. Use superscript lowercase italic letters for table footnotes, which should be typed immediately below the table. Type tables at least double-spaced, including titles and footnotes. Do not underline table titles; reserve underlining for text that is to be italicized.

**Equations.** Equations should be typewritten whenever possible and the number placed in parentheses at the right margin. Reference to equations should use the form "Eq. (3)" or simply "(3)." Superscripts and subscripts should be typed or handwritten clearly above and below the line, respectively. Use the exponent  $1/2$  whenever possible.

**References.** References should be cited in the text by a number in square brackets. Literature cited should appear on a separate page at the end of the article and should be styled and punctuated according to the standards of the American Physical Society and using standard abbreviations for journals (see *Chemical Abstracts Service Source Index*, 1985). See the following examples:

1. D. SCHNACK AND J. KILLEEN, *J. Comput. Phys.* **35**, 110 (1980).
2. I. GOHBERG, P. LANCASTER, AND L. RODMAN, *Matrix Polynomials* (Academic Press, New York, 1982), p. 54.
3. R. GROSS, M. KOYANAGI, H. SEIFERT, AND R. P. HUEBENER, in *Proceedings, 17th Int. Conf. on Low Temperature Physics, Karlsruhe, West Germany, 1984*, edited by U. Eckern *et al.* (North-Holland, Amsterdam, 1984), p. 431.

For unpublished lectures or symposia, include title of paper, name of sponsoring society in full, and date. Abbreviation of DOE Laboratory report names should follow the style of *Nuclear Science Abstracts*. Give titles of unpublished reports with "(unpublished)" following the reference. Further examples and instructions are available from the Editors.

**Footnotes.** Footnotes in the text should be avoided if at all possible. If they must be used, identify by superscript numbers and type together on a separate page, double-spaced.

**Figures.** All illustrations are to be considered as figures. Number each graph or drawing in sequence with Arabic numerals. Supply a descriptive legend for each figure. Type legends double-spaced consecutively on a separate page.

Plan figures to fit the proportion of the printed page. Use a professional lettering set on the original so that the letters and numbers are large enough and "open" enough to take a reduction of 50 to 60% without filling in the ink. Do not include background grids; however, on paper with blue lines the grid can be eliminated in the process of photoreproduction. Identify each figure in a margin with the name of the journal, author's name, and figure numbers; avoid marking the backs of figures.

**Proofs.** Proofs will be sent to the author with a reprint order form. Authors will be charged for alterations in excess of 10% of the cost of composition.

**Reprints.** Fifty reprints without covers will be provided free of charge. Additional reprints may be purchased.